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Mangetotransport in Topological Materials Based on IV-VI Semiconductors and Tin

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Topological materials are promising candidates for future electronics and spintronics as well as of great interest for fundamental condensed matter physics. One of the classes of the topological matter is topological crystalline insulators, where topological protection arises from crystal symmetries rather than time-reversal symmetry. This phase is realized in the IV-VI semiconductor compounds of appropriate composition. In the talk I will present our recent results on weak antilocalization in thin layers of IV-VI semiconductor $Pb_{1-x}Sn_xSe$ [1], which is observed in both topological and trivial phases. However, it was found to be sensitive to the presence on the surface of amorphous insulation layer. This sensitivity is theoretically explained by the symmetry protection of the Berry phase, which is insensitive to the band ordering. These findings align qualitatively with the spin-resolved ARPES measurements, which point that helical spin texture is preserved through the topological phase transition [2]. Furthermore, embedding thin films $Pb_{1-x}Sn_xSe$ between PbEuSe barriers form a quantum well, which allowed us to observe quantum Hall effect in these compounds. Extensive numerical k*p modeling of such structures suggests potential routes for the quantum spin and anomalous Hall effects in IV-VI compounds. If time allows, I also present our results on the behavior of the layers of a-Sn grown on an insulating CdTe that host topological semimetal phases, such as Dirac and Weyl semimetals. Thermoelectric and magnetotransport behavior in these films points to the chiral anomaly behavior in higher magnetic fields [3,4].

[1] A. Kazakov et al., Phys. Rev. B **103**, 245307 (2021)
[2] B. Turowski et al., Appl. Sur. Sci. **610**, 155434 (2023)
[3] J. Polaczyński et al., Materials Today **75**, 135 (2024)
[4] Md.S. Alam et al., Phys. Rev. B **109**, 245135 (2024)